Risk Assessment Modeling Approach for the Prioritization Of Oil Removal Operations from Sunken Wrecks

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Great need for assessment of environmental risks from shipwrecks

- Worldwide over 8,500 potentially polluting shipwrecks
- 1,500 tank ships and 7,000 non-tank vessels (>400 GRT)
- Estimated 2 - 20 million tonnes of oil on board
- 75% of these wrecks are from WWII.

Wreck removal convention 2007

The Convention seeks to lay down a uniform set of rules for dealing with a wreck (incl. cargo & bunkers) and its removal. In this respect the Convention reflects current convention practice but with the very significant introduction of compulsory insurance and the right of action directly against that insurer.

Removal of oil from individual leaking wrecks = REACTIVE STRATEGY

Comparing Strategies

- REACTIVE - Deal with continuous leaking or sudden release oiling events and damages as they occur – greater costs for spill response and damages, risk remains

OR

- PROACTIVE - Take proactive approach to remove oil from wrecks with greatest risk – highest potential for leakage or spillage and highest damages – lower costs, risk removed
**Risk-Based Proactive Strategy**

- Identify wrecks with greatest potential for leakage or sudden oil release
- Conduct risk analyses of impacts and costs of leaks and spills from wrecks
- Compare costs/impacts of “leave alone” strategy vs. planned oil removal operations
- Prioritize wrecks by risk
- Remove oil from riskiest wrecks

**Benefits of Risk-Based Approach**

- Reduce threat of leaking oil from sunken wrecks
- Apply scientifically-based rationale for removal operations
- Reduce costs, damages, and environmental impacts
- Provide excellent training for response and salvage personnel
- Demonstrate state-of-the-art salvage and response strategies
- Cooperative effort between industry and governmental agencies

**Risk = probability x impact**

- Need to determine probability of leakage/spillage based on vessel type and condition, environmental factors - underwater/on-site surveys/engineering
- Need to determine type of leakage (chronic, episodic, massive release) - underwater/on-site surveys/engineering
- Need to determine probabilistic impacts for various scenarios - modeling

**Determining Probability of Leakage**

- On-site/underwater surveys to determine exact location, prevalent weather/current patterns, historical condition, water depth, physical condition and position, type of steel, effects of steel corrosion, site vulnerability, and tank inspection for remaining product.
- Preliminary desk study to determine vessel history and possible cargo/fuel contents
- Steel corrosion studies have shown rate of corrosion penetration to be approximately 0.064 – 0.074 mm/year, and field studies have shown even higher rates of up to 0.115 mm/year (Wrubel 2007).

**Oxygen concentration as a function of depth**

- Oxygen concentration and initial steel corrosion rate

**Temperature vs. seawater depth**

- Corrosion vs. mean annual temperature (M.A.T.)
Modeling as Risk and Averted Cost Assessment Tool

- Determine fate and impacts of potential spillage/leakage by scenario
- Quantify damages and costs from spill
  - Response costs
  - Environmental damages
  - Socioeconomic damages
- Simulate hypothetical spills for response planning or best timing of removal and environmental salvage operations
- Quantify averted damages from environmental salvage operations

**SIMAP™ Modeling**

Integrated Oil Spill Impact Model System

- Three-dimensional simulation of oil behavior, transport, fate, and effects
- Stochastic (probabilistic) scenario modeling
- Spill response strategy modeling – dispersants, mechanical, burning
  
  Coupled with ERC risk and cost modeling to provide complete state-of-the-art risk and cost-benefit modeling package

**T/V Coimbra**

423-foot British flag tanker attacked, torpedoed, and sunk by a German submarine on January 15, 1942
Resting in 180 feet of water 20 miles south of Long Island, New York

28,500 barrels (4,070 MT) of lubricating oil remain onboard in eight cargo tanks.
Winds may keep oil off shorelines, but, in worst case, if shoreline impact does occur, there could be considerable oiling of southern Long Island and New Jersey shoreline.

Worst case aromatic concentration – four hour spill

Worst case aromatic concentration – seven day spill

T/V Norness


107,000 barrels (15,285 MT) of No.6 fuel oil (heavy oil) remain onboard.

T/V Norness Hypothetical Spill Scenarios

15,285 MT heavy No. 6 fuel oil

Probability of surface oil – four hour spill

Probability of surface oil – seven day spill

Estimation of Environmental Salvage Operations Costs

- Highly dependent on water depth
- Situation-specific
- Costs can be controlled with pre-planning, project management, use of proven technologies, informed contracting, seasonal timing of operations
Cost-Benefit Analysis

- Benefit of wreck oil removal operation = averted costs and damages
- Benefit should exceed cost of operation
- Immeasurable benefits need to be considered

Risk-based Approach

- Provides quantifiable measure of benefits
- Allows for prioritization of wrecks by quantifiable risk
- Provides powerful decision-making tool

Tools & Techniques

Cargo / bunker removal – intervention tools
- Hot tap
- Submersible hydraulic pumps
- ROV/remote operated pumping tools
- Special designed one-off equipment
- Heating/ water injection equipment
- Auxiliary equipment ( non invasive)
SPECIAL TOOLING: PIPE PENETRATION SAFETY VALVE (PPSV)

Remote operated offloading system (ROLS)

Neutron backscattering device tested

Neutron backscattering system:
Measuring changes in density of hydrogen contained in water, oil or other emulsions.

Frame identification

Frame identification
INTERVENTION METHODOLOGY:

THANK YOU